U. S. DEPARTMENT OF AGRICULTURE

FARMERS' BULLETIN No. 1555

PEPPERMINT and SPEARMINT as FARM CROPS

THE CULTURE of peppermint and spearmint and the distillation of oil from these plants in the United States is centralized in Indiana, Michigan, western Oregon and Washington, and in a few other localities where conditions especially favor the crop, but the industry is capable of considerable expansion in these and other localities if greater commercial demands for the oils should develop. The total area of mint under cultivation in the United States is estimated at about 35,000 acres, of which about 10 per cent is spearmint.

Mint culture was first introduced in New York, but declined rapidly there when large areas of fertile muck land in southern Michigan and northern Indiana were found to be well adapted to the crop. In this region mint culture has become highly specialized. Similar types of land are in successful use for mint in the Pacific Northwest, from which region about 15 per cent of the total production of mint oils in this country is obtained. In recent years the industry has been developed on a commercial basis in central California and eastern North Carolina.

Mint growing, if intelligently conducted, brings fair acreage returns to those who engage in it as an established farming operation. The crop is very susceptible to unfavorable weather, especially in the spring, and the yield of oil per acre therefore varies greatly from year to year. The market demand for mint oils is steadily increasing, but a sudden and considerable increase in production would no doubt have a most unfavorable effect on the industry.

This bulletin supersedes Farmers' Bulletin 694, entitled "The Cultivation of Peppermint and Spearmint."

Washington, D. C. Issued February, 1929

PEPPERMINT AND SPEARMINT AS FARM CROPS

By ARTHUR F. SIEVERS, *Senior Biochemist, Office of Drug, Poisonous, and Oil Plants, Bureau of Plant Industry*

CONTENTS

INTRODUCTION

COMMERCIAL MINT CULTURE was introduced into the United States more than 100 years ago, when it became established as an industry in Wayne County, N. Y. (Fig. 1.) Both peppermint and spearmint yield an essential oil which is the principal marketable product, although there is a limited use for the dried herb of peppermint. Spearmint has long been grown as a culinary herb, but its culture for this purpose is limited to the home garden. Peppermint oil, which is the most important of the mint oils, enters into numerous medicinal products, but its principal use is for flavoring candies, chewing gum, and tooth pastes. Spearmint oil is less in demand because its use is confined almost exclusively to the flavoring of chewing gum.

From New York peppermint culture extended westward, first to northern Ohio and later to southern Michigan, where the first planting was started in St. Joseph County as early as 1835. The success of this venture led to the extension of the industry in the southwestern part of the State and into the northern counties of Indiana. The large areas of muck soil in this region were found to be so well adapted to mint culture that it soon became the center of production, while in central New York the plantings were gradually diminished until at present less than 50 acres are devoted to this crop in that section. The area planted to peppermint in Michigan and Indiana is reported to have reached 40,000 acres in the last few years. Only part of this area, however, has yielded productive harvests.

The success that attended mint culture on the muck lands of the Middle West naturally led to experimental plantings in other parts of the country where areas of similar land were available. About 20 years ago it was found that the soil and climate of western Oregon

were very favorable for the crop, with the result that the Pacific coast is at present the second most important production center. Reclaimed muck lands along the Willamette River in Oregon and along the Columbia River in Oregon and Washington are now devoted to this crop to the extent of about 2,000 acres. Smaller areas in southwestern Oregon and in the Yakima Valley of southern Washington bring the total area devoted to mint culture in the Pacific Northwest to about 3,000 acres. In the past few years the industry has also become established in a small way on the San Joaquin River lands in Tulare and King Counties, Calif. The reclaimed muck land in the Dismal Swamp section of eastern North Carolina has also been found suitable for mint. Although less than 100 acres are at present under cultivation in that section, it is very probable that the acreage will be gradually extended.[1]

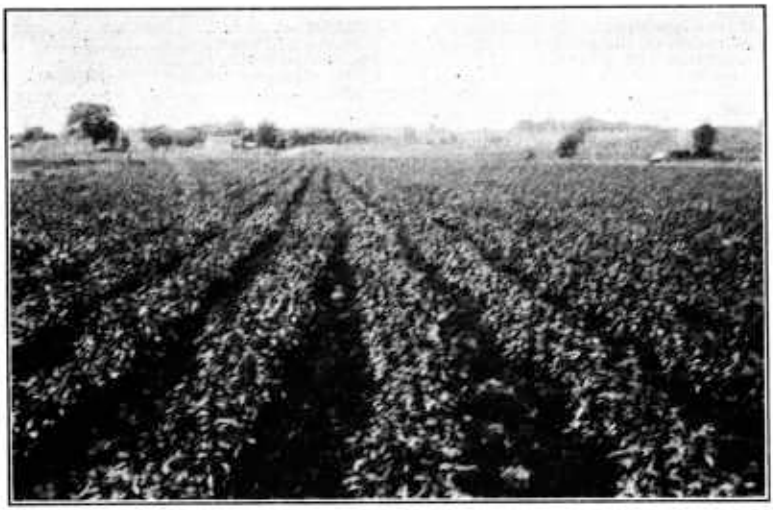

FIG. 1.—A field of first-year peppermint in Wayne County, N. Y.

The acreage of spearmint is relatively very small. Several thousand acres are scattered throughout the Michigan-Indiana district, and small areas are under cultivation in the other regions referred to.

TYPES AND DESCRIPTION OF MINT PLANTS

Peppermint, known botanically as *Mentha piperita* (fig. 2), occurs in two commercially important forms, usually referred to as black mint and white mint. Both varieties yield the peppermint oil of commerce, but they differ somewhat in their adaptiveness to the cultural conditions found in this country. The white mint is generally

[1] Farmers in the principal mint-growing sections are referred to the following publications for further information:
BOUQUET, A. G. B. PEPPERMINT PRODUCTION FOR OIL. Oreg. Agr. Col. Ext. Circ. 221, 5 p. 1925. [Mimeographed.]
DUNCAN, J. R. PEPPERMINT GROWING IN MICHIGAN. Mich. Expt. Sta. Spec. Bul. 153, 11 p., illus. 1926.
WOODBURY, C. G., and SAYRE, C. B. MINT GROWING IN NORTHERN INDIANA. Ind. Agr. Expt. Sta. Circ. 65, 14 p., illus. 1917.

considered to yield a finer oil than the black mint, but it is noticeably less hardy and on the whole is less productive than the black mint. The latter was introduced into this country from England and is the variety now almost exclusively grown in the commercial mint districts. It has dark-purple stems and deep-green, broadly-lanced

FIG. 2.—Peppermint (*Mentha piperita*) in bloom

leaves, slightly toothed. The white variety has green stems and light-green leaves, more pointed, and deeply toothed.

Spearmint (*Mentha viridis*) (fig. 3) has many of the characteristics of peppermint but can readily be distinguished from it. The leaves are longer and of a lighter green color, and the flower spikes

are more pointed. It has a less agreeable odor than peppermint, and the two are not readily confused by those who recognize the distinctive characters of the oils.

A number of forms of native mint occurring naturally in many parts of the United States contain oil, but it is of poor quality.

FIG. 3.—Spearmint (*Mentha viridis*) in bloom. The rootstock or runner shown is typical of the underground portion of the mints

These plants have no commercial value, and if mint culture is to be undertaken on land where they occur they must first be thoroughly eradicated before the commercial variety is planted, for if allowed to remain to any considerable extent they will unfavorably affect the quality of the oil obtained.

The mints are perennial plants with square stems. They produce profuse blooms but rarely set seed. They reproduce readily, however, by means of abundant runners which spread in all directions near the surface of the ground, sending up new growth at the nodes or joints. The plants grow to a height of 3 feet, or more if the soil is rich and if they are crowded. When grown in rows or if kept sufficiently thinned out the plants develop numerous side branches and assume a bushy character. The oil occurs in numerous minute glands on the under surface of the leaves. From this it is obvious that the yield of oil depends largely on the proportion of leaf surface present. It is important, therefore, that the cultural practices employed be such that the plants may develop as much of the bushy character as possible.

CULTURAL DIRECTIONS

SOIL REQUIREMENTS

The mints prefer deep, rich soil, well drained but retentive of moisture, and of fairly open texture to permit easy root penetration. Land that contains a large proportion of clay and is so situated that drainage is slow can not be successfully used for this crop. An abundance of humus is desirable, and experience seems to have shown that a nonacid soil is necessary. These preferred conditions are most readily available in well-drained swamp lands, usually referred to as muck soils, which have been so successfully used for growing celery, onions, cabbage, and similar crops that require the quickly available soil elements necessary to produce strong and rapid growth. Upland fertile sandy or gravelly loams of good depth and proper texture that will produce potatoes and corn are also reasonably suitable for mint culture. Such soils were at one time used extensively for this purpose, especially in Wayne County, N. Y., but at the present time upland mint culture has been almost entirely abandoned in the principal mint-producing regions. The opinion prevails that on such lands the crop can not be maintained in a clean and thrifty condition as long as on muck soils.

The large level tracts of muck lands common in Michigan and Indiana are subject to severe blowing in the spring after prolonged drought, when strong winds lasting several days are not unusual. The fine particles of sand present in the muck, driven by the wind, gradually cut to pieces the tender young growth and thus cause extensive damage. In areas where the landscape is broken by occasional stands of timber the damage from blowing is much less. The use of windbreaks gives promise of reducing damage from this cause. Figure 4 shows strips of rye planted in a large field of first-year mint to serve as windbreaks. Permanent plantings of willows for this purpose have also been made.

Although the largest areas of muck lands are available in the Michigan-Indiana district, extensive tracts also occur in the Pacific Northwest. In Oregon the so-called "beaver dam" lands in the Willamette Valley are of the same general character as the midwestern muck soils, and these are coming into extensive use for mint

culture, the most notable example being in the Lake Labish district. (Fig. 5.) These areas have been ditch-drained and cleared of timber and provide an unusually rich soil. Smaller areas of the same character are found in other parts of the Willamette Valley. These lands are subject to annual overflow of the Willamette River early in the spring. The water table follows the level of the river and is controlled largely by means of gates in the drainage ditches. By means of these ditches the underground water level may be raised high enough during the dry summer season to bring moisture up to the roots to the extent necessary. On the islands in the Columbia River, particularly on Puget Island, and along the mainland in the vicinity of Cathlamet and Skamokawa, Wash., are considerable areas of muck and river-bottom lands which have come into important use for mint culture. (Fig. 6.) These lands have been reclaimed by means of dikes. Another important district is the Portland flat, on

FIG. 4.—Rye grown as a windbreak in a large level field of first-year peppermint on muck soil

the south side of the Columbia River at Portland, Oreg. Small pockets of bottom land which can be made available for the crop are to be found in many places in this general region extending from southwestern Oregon to Puget Sound.

Next in importance as mint land in the coast district is the sandy-loam soil. This land is found at a higher elevation along the Willamette River. It also is drained by ditches or dikes and in most cases is subject to overflow in the spring. Such soil types are planted to mint in the vicinity of Eugene and Salem, Oreg., and Woodland, Wash. On the whole, this soil produces a lighter crop of mint than the muck soils already described, but with good cultural practices they have been found to be very well adapted to the crop.

Within the last few years, as a result of two seasons of abnormally high oil prices, mint farming under irrigation has been introduced in the Yakima Valley in Washington on lands heretofore largely devoted to alfalfa and fruit. Small areas have been planted in the several irrigation districts extending from Sunnyside in the south-

central part of the State as far east as Kennewick. The soil in this region is mainly a sandy loam, but some plantings have been made on clay soils. Mint growing in this district has hardly passed the experimental stage, and its probable future under conditions existing there can not be predicted at this time.

PREPARATION OF THE GROUND

Land selected for mint culture should preferably be summer-fallowed for a year or planted to some crop that requires frequent and clean cultivation, in order to remove from the soil most of the weeds which cause a great deal of trouble in a mint field. The eradication of perennial grasses is especially desirable, because after

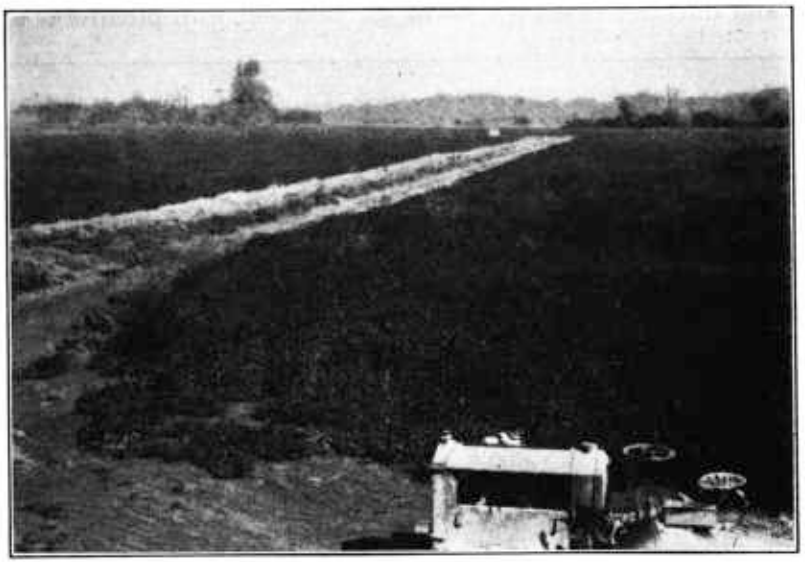

FIG. 5.—An old peppermint field in the Lake Labish district, near Salem, Oreg.

the mint has spread beyond the planted rows and the ground can no longer be frequently worked with deep cultivators they are difficult to destroy or control.

In the Middle West the muck land to be planted to mint may be plowed in either fall or spring. Fall plowing is preferred by some growers because there is then more time available, and the ground can be prepared for planting somewhat earlier in the spring. If fall plowing is not practicable the plowing should be done early in the spring or as soon as the land is dry enough to permit teams or tractors to operate. After plowing, the field is disked and thoroughly harrowed and frequently rolled in order to pack the loose soil. If the land is plowed in the fall it will be firmer in the spring, and it may be necessary to disk it in both directions in order to get it in the best condition. In the coast district fall plowing is

not generally recommended for lands that are subject to overflow during the winter and early spring, because of the greater danger of the soil washing when in a loose condition.

PROPAGATION AND PLANTING

PROPAGATION BY RUNNERS

Runners for planting are obtained from a field previously selected for the purpose, usually one that had been planted during the preceding spring. In order to assure the best quality of planting stock, only a field that had produced a thrifty, vigorous stand should be set aside for this purpose. The removal of the runners from the ground is accomplished in several ways. The rows may be plowed out and the runners shaken out of the loose soil with pitchforks and

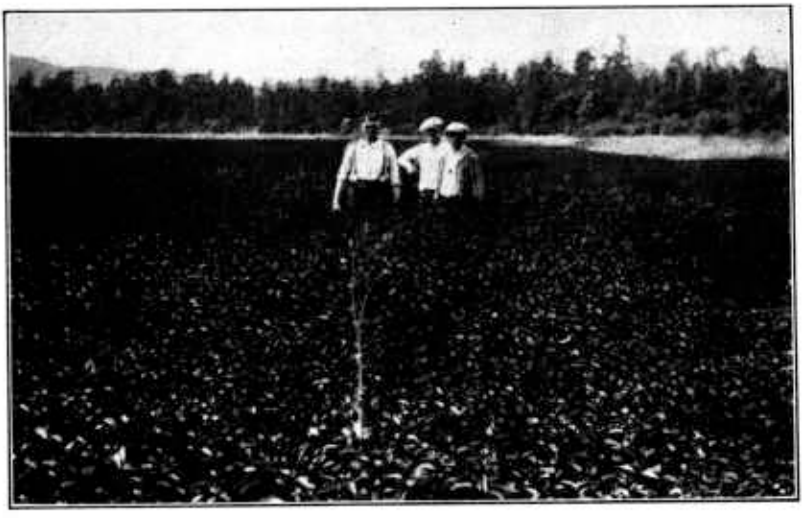

FIG. 6.—A field of old peppermint on Puget Island, Wash., in the Columbia River

deposited in convenient piles, or a potato digger may be used with a considerable saving of hand labor if the condition of the land makes the use of heavy implements possible. In the coast district runners are frequently dug from older fields in muck soil where the plants have become broadcast and the ground is crowded with runners. The field is cut with some convenient implement into blocks about 18 inches square which are then lifted with a pitchfork and the soil shaken out. The yield of runners in such cases is reported to be very large.

As a rule, mint runners become established after planting with little difficulty, provided they are in good condition when planted and growing conditions are favorable. Their vitality is easily affected, however, if they are permitted to wilt through exposure to the sun or wind. The approved practice, therefore, is to cover the piles of runners with dirt or other material if they are not to be immediately planted. Planting in very dry soil is inadvisable, es-

pecially if there is no prospect of an early rain. In order to retain as much moisture as possible in the furrows these should not be laid off faster than the planting proceeds, so that the runners may be laid in the slightly damp soil. For the same reason the runners should not be left exposed in the furrows but should be immediately covered.

Planting is started as early as conditions warrant. In the West it usually begins early in March, but in the central district the muck lands are not generally in workable condition until a month or more later. The ground should be reasonably warm and not too wet. Prolonged cold and wet weather immediately after planting frequently causes the runners to rot. Late spring frosts following a period of warm growing weather which has caused the young growth to appear above ground do much damage. While the destruction of this new growth by frost does not kill the runners, it depletes their strength and frequently prevents a full crop from developing.

Immediately before planting, the field, previously prepared as described, is laid off in furrows about 3 feet apart and 4 inches deep with some suitable implement. Usually a homemade drag with proper furrowing tools attached is found to be very satisfactory. Planting is done either by hand or by machines. The hand planter carries a sack full of runners so strapped around his shoulders that the runners may be readily taken out of the opening. He drops the runners into the furrows lengthwise and generally end to end. As he moves along he pushes the dirt over them with his foot and packs it down by walking on the row. If the runners are not satisfactorily covered by this method the covering may be completed by means of a leveler or shovel plow. An experienced mint planter can plant nearly an acre a day on an average, but inexperienced help will not average more than half an acre. These estimates are based on the practice of laying the runners end to end in rows 3½ feet apart. Much depends also on the condition of the soil. Deep loose soil which makes walking laborious naturally slows up the planter. The condition of the runners used is also a factor.

In recent years machine planting has come into general use, especially on the large mint farms. A number of machines have been designed that have made it possible to plant quickly large areas for which sufficient hand labor is not always available. It is claimed also that these machines reduce the cost of planting.

The quantity of runners required to plant an acre of ground depends on the spacing of the runners in the furrows and the distance between the furrows. An acre of well-established mint, in which there has been no winter damage, will frequently yield enough runners to plant 20 acres, but on an average only enough for 10 or 15 acres are obtained. If a grower is selling runners to another grower in the same locality the usual practice is to sell a designated area in the field and let the buyer dig the runners and haul them away. If runners are sold to distant points they are usually packed in grain sacks and shipped with as little delay as possible. Even under the best conditions there is generally some loss in such planting stock, either from drying out or from decay due to too much moisture and lack of ventilation. The cost of runners depends

largely on the demand. When oil prices are high there is usually a brisk demand for planting stock, which brings an increased price as a result. Seventy-five dollars is generally considered a fair price for runners from an acre if the buyer digs them himself. Assuming that the runners from 1 acre will plant 10 acres, the cost of planting stock at this rate is $7.50 an acre. Runners shipped in sacks sell for about 75 cents a sack of 2-bushel capacity, f. o. b. shipping point, under normal conditions, but much higher prices have been obtained at times. About 20 sacks are required on the average to plant an acre. Under normal circumstances new growers usually purchase only sufficient runners to plant a few acres and in subsequent years enlarge their plantings at a comparatively small cost by means of the stock thus obtained.

PROPAGATION BY YOUNG PLANTS

In the last few years considerable attention has been given to planting new fields with young plants instead of with runners. In a well-established mint field innumerable young plants that sprout from the joints or nodes of the runners will appear in the spring. When these new growths are about 4 or 5 inches high they may be readily pulled out of the ground, especially out of muck soil, with a small cluster of fibrous roots at the base of the stem. Such young plants can be successfully transplanted under reasonably favorable conditions after permanent warm weather has arrived, late in May or early in June. Machines such as are used for transplanting tomatoes, cabbages, and similar plants have been found useful for setting these young mint plants in the field. They are operated by three men, one driver and two setters. At least two men are required to pull the plants from the field, and sometimes one additional man is needed to transport them from the field to the planter. Such a crew, it is reported, can plant from 3 to 4 acres a day, setting the plants 1 foot apart in rows 3 feet apart.

The use of young plants instead of runners for starting the mint field has a number of advantages. The planting can be undertaken late enough in the spring to avoid the cold weather which so frequently retards or even destroys the fields newly planted with runners. Such fields can not always be replanted with success, with the result that in years when unfavorable spring weather prevails a considerable percentage of the acreage planted to new mint is in such poor condition that it is not harvested. It is probable, therefore, that if the practice of starting new fields with plants instead of runners is more generally adopted it may have a decided influence in minimizing the effects of unfavorable spring weather on the extent of the mint crop.

CULTIVATION

The mints require frequent cultivation to keep the ground in the most favorable condition for root penetration and to control the growth of weeds. Frequent use of fine-toothed harrows and weeders or rotary hoes (figs. 7 and 8) is recommended on both old and new fields. These implements do but little damage to mint plants 5 or 6 inches in height, and if used frequently for stirring the ground

when the weeds are very small they are a very efficient means of control. In new fields cultivators are used frequently between the rows until the spread of the runners into the open spaces makes further tillage inadvisable.

Old fields are worked with spring-toothed cultivators or harrows as early in spring as possible. This loosens the soil and promotes the growth of the plants from the runners and at the same time destroys many of the weeds. If the ground is well filled with runners and new growth appears in great abundance this practice may be continued for some time, since the thinning out that results from the use of such implements is on the whole beneficial to the crop, which otherwise has a tendency to become too dense. However, cultivation in old fields can not be continued long enough to control the weeds entirely unless the field has been kept very clean in previous years. Hand weeding is therefore usually necessary, and weeding crews are sent through the fields several times during the summer to remove the weeds that are most likely to damage the oil. Nettles, mare's-tail, pigweed, and smartweed are common and very objectionable. Some weeds color the mint oil, while those which in themselves contain oil with a pronounced odor are particularly to be avoided. Various grasses frequently cause considerable trouble. Although these may not unfavorably affect the oil to the same extent as the weeds mentioned, they are difficult to eradicate, since most of them are perennials and spread rapidly by means of their rootstocks under the conditions usually found in the older mint fields. In some localities the fields must be abandoned after two or three years on account of such grasses, which, as a rule, are a more serious problem on upland than on the looser muck soil.

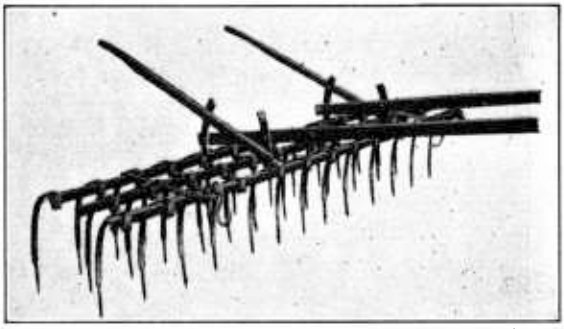

FIG. 7.—A fine-toothed harrow used in mint fields to control weeds

After the mint crop has been removed the fields receive no further attention until late in the fall. In the central and eastern districts they are plowed before the first heavy frost is likely to occur. Earlier plowing may be followed by warm weather and is therefore not advisable, since in order to avoid winter damage the runners should remain entirely dormant after they have been turned under. Fall plowing is especially desirable because the runners are comparatively close to the surface and are subject to much winter damage if not plowed under 4 or 5 inches. In the case of spearmint the fields frequently are not plowed until spring, since the runners of this mint are deeper in the ground. In the coast district fall plowing is recommended only on land that does not wash during the heavy winter rains or the spring overflow. If fall plowing is satisfactory this

should be done as late as possible, but before the advent of the heavy rains, which rapidly make the land too soft for plowing.

In subsequent years the cultural requirements are the same as in the second year. On rich soil the stand frequently becomes too thick unless winter damage occurs, and in such cases more frequent use of cultivators is advisable in order to thin the stand. Weeds and grasses become more numerous, and the gradual depletion of necessary soil elements results eventually in smaller returns. When this condition is reached it is best to plow out the mint and plant the land to other crops for several years. Upland soils will not usually maintain a profitable mint crop for more than three years, largely because of the difficulty of controlling weeds and grasses. Muck soils with their

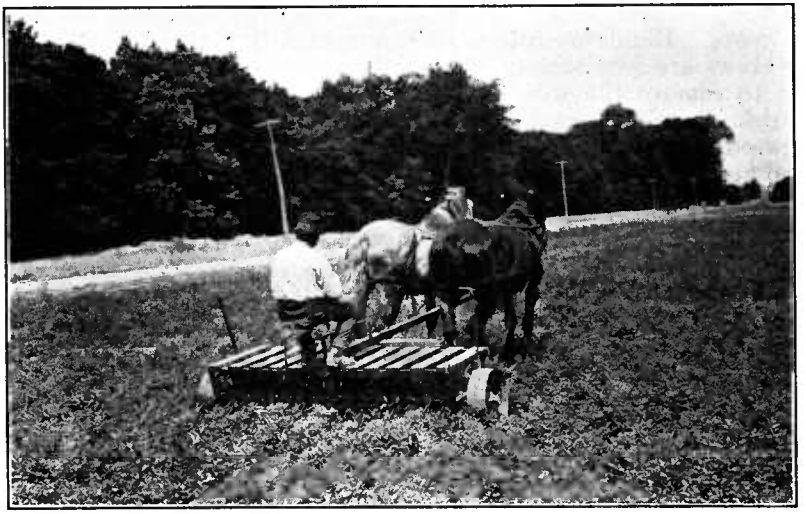

FIG. 8.—A rotary hoe in use on an old mint field early in the summer

greater natural fertility and with the loose texture that permits more efficient control of the weeds have occasionally been cropped continuously to mint for six or seven years without being replanted.

FERTILIZERS

The fertilizer requirements of the mints are not well understood and have not been the subject of systematic investigations. Observations by successful growers, however, indicate that the crop is noticeably benefited by a judicious application of commercial fertilizers in accordance with the special requirements of the land used. It has already been stated that the crop is best adapted to nonacid soils; hence the application of several tons of a neutralizing material such as ground limestone is necessary if acid soils are used. A deficiency of potash in the muck soils has frequently been observed, which has led to the practice of applying from 100 to 200 pounds of the sulphate or muriate of potash to the acre. Regarding the use of phosphoric acid there is less agreement among the growers, but a reasonable application to land that is distinctly deficient in this respect is

no doubt of value. Most of the newly reclaimed swamp lands that are coming into general use for mint culture in the coast district contain sufficient nitrogenous material resulting from decomposition of the large quantity of vegetative matter present to furnish the quickly available elements needed for rapid and vigorous growth. On similar soils that have been cropped for longer periods, as is the case in the central district and on upland soils, the mint crop is much benefited in the early part of the season by the application of 100 to 150 pounds of nitrate of soda to the acre. The use of barnyard manure for this purpose has not been found advisable, because it introduces a great many weed seeds unless it has been very thoroughly rotted. However, the liberal use of manure in the preceding year when the land is planted to a crop that permits frequent cultivation and a

FIG. 9.—A fine stand of first-year spearmint in Michigan ready for harvesting. This field, photographed about September 1, was damaged by frost about a month previously, but made a good recovery

thorough destruction of weeds is of great benefit. The return of the spent mint herb from the still to the field as a source of nitrogenous fertilizer is generally considered to be good practice.

HARVESTING

Both peppermint and spearmint contain the maximum amount of oil when the plants are in bloom, and so far as possible the harvesting should take place at this stage. (Fig. 9.) The flowers on the individual plants do not all open at the same time; therefore the period of blooming is relatively long. When large acreages are to be harvested it is best to start when the early flowers are in bloom, unless the distilling equipment is ample to handle the entire crop in a very short time. In this way when the last part of the crop is cut the plants will not have passed considerably beyond the main blooming stage. The oil content diminishes rapidly as the foliage begins

to fall with the passing of the flowering period, and the loss of oil resulting from a harvest too long delayed is greater than that resulting if the crop is cut somewhat early. New mint reaches the proper harvesting stage several weeks later than old mint, which makes it possible for the grower to harvest his old fields before the new ones are ready.

In eastern North Carolina harvest begins early in July. In California also most of the crop is ready in this month, while in Oregon and Washington harvesting generally takes place from the 1st to the 15th of August. The later arrival of spring weather in the central district makes the harvest period there extend through August and sometimes well into September. In all these districts, however, unusual weather conditions in some years advance or delay the harvest several weeks. In the coast district two harvests are frequently obtained. In California especially, this practice is general, since the longer growing season and the late arrival of fall rains are favorable conditions for this purpose. In Oregon and Washington, on the other hand, it is generally necessary to cut the first crop rather earlier than usual if it is desired to bring a second growth to reasonable maturity before heavy rains reduce the yield of oil and seriously interfere with the proper curing of the herb in the field. Early harvesting is also sometimes necessary on the fertile muck soils when the stand is very thick and rank. Under such conditions a considerable loss of leaves occurs before the blooming period is reached, and to avoid this it is better to cut the crop early. On such fields there is a good opportunity to develop a reasonably productive second crop. The oil obtained from immature herb is frequently of inferior quality and is lacking in those characteristics that the market demands. The two-crop practice therefore is of doubtful value even if the yield of oil is larger, unless the seasonal conditions make it possible to cut both crops in a reasonably mature condition.

Harvesting is accomplished by both hand and machine methods, according as conditions make one or the other the more practicable. New mint in rows is very frequently cut with scythes, especially if the rows are somewhat ridged. Even on some of the largest mint farms this method of harvesting new mint is preferred. A large crew of men is put into the field, each man following a row, cutting first from one side and then returning along the same row and cutting from the other side. The row is thus cut close to the ground and no herb is wasted. Mowing machines have been adapted for cutting new mint with a minimum loss of herb. Several large guards attached to the sickle bar lift the lower branches from the ground and thus prevent the tops from being cut off and lost. Older mint that has spread all over the field is harvested with mowers drawn by either horses or tractors, the latter being especially equipped for the purpose with a sickle bar operated by direct drive. (Fig. 10.)

After the mint is cut it is allowed to lie in the swath for a day or longer until it is partially dried, when it is raked into windrows with a side-delivery rake. If the weather is fair and drying proceeds rapidly it may be hauled from the windrows to the still. In dull weather it is frequently necessary to place the herb in small cocks like hay, to continue the curing. (Fig. 11.) Some growers prefer

this method as a regular practice, while others find it more economical to load directly from the windrow with hay loaders. Complete drying so that the herb is brittle is carefully avoided, because in such condition it can not be handled without the loss of foliage and a resulting loss of oil.

For hauling the herb the ordinary flat hay racks have been found very serviceable. Onto these the material can be loaded with the least labor and a minimum of shattering. On one of the largest mint farms in the country the herb is loaded and firmly packed directly into large metal forms hauled on low-bodied wagons. On arrival at the still the entire load is lifted out of the form by means

FIG. 10.—Harvesting spearmint with a tractor mower in Michigan

of lifting chains attached to a sling, which is laid on the bottom of the form before it is loaded. The crane swings the load directly over a distilling tub,[2] into which it is then dropped. The forms are a trifle larger than the tubs and slightly wider at the top than at the bottom, which permits the load taken from it to fit snugly into the tub and to fill it completely. By this method the time required for unloading and charging a tub is greatly reduced. It has the further advantage that loss of oil due to handling the herb with pitchforks or hayforks is avoided. The general practice, however, is to transfer the herb to the tub by means of pitchforks or to use some form of hayfork operated by a team of horses or by a crane and windlass. In some of the newer distilling plants steam-hoisting cranes are in successful use.

[2] Several terms, such as "tub," "vat," and "retort," are commonly used to designate that part of the distilling equipment in which the herb is packed.

DISTILLATION OF THE OIL

The process employed for removing the oil from mint is very simple. It consists of passing a current of steam through the herb, whereby the oil is vaporized and the steam and oil vapors are conducted through a worm or other form of condenser where they are condensed to water and oil. The water and oil are collected in suitable receivers, in which they separate into layers, the oil floating on the surface of the water. Although the equipment used for this purpose has been gradually improved, the method of operation has on the whole remained unchanged.

DESCRIPTION OF STILLS

A distilling equipment consists of a boiler for generating steam, a tub, a condenser, and a receiver. The general arrangement of these several parts may vary according to conditions, but the whole equipment should be so assembled that the outfit may be installed at the

FIG. 11.—A mint-harvesting scene in Michigan

lowest cost and operated with the greatest saving of labor. Even the smallest distilling units include two tubs operated with one condenser, so that one may be charged while the other is being distilled. On the larger farms one usually finds four tubs operated in pairs with a condenser for each pair. (Fig. 12.) These tubs are set down part way in a wooden platform which serves as a working floor, the tubs projecting usually about 2 feet above this floor. A lifting crane with windlass is mounted between the two tubs of a single unit, or in the center of the platform in the case of a two-unit outfit, so that it may be used for loading and discharging each tub.

The tubs in use vary somewhat in size, but are generally designed to hold one load of herb. They are 6 to 9 feet in height and diameter, most of them measuring 7 feet in both directions. Some are of slightly larger diameter at the top than at the bottom, to facilitate the removal of the spent herb. In the early years of the industry they

were constructed entirely of wooden staves, and many such are still being built, but the tendency at present is to construct them of heavy galvanized steel. The wooden tubs are built like stave vats or cisterns, held together with adjustable iron rings. In the top edge is a groove about half an inch wide in which is set a strip of heavy felt or some other suitable material which projects slightly above the edge. The cover of the tub, which is constructed of narrow wooden planks properly reinforced with crosspieces, rests on this strip, which permits it to be clamped down, thus making it steam tight. The clamps, consisting of threaded iron rods fitted with turn bars, are hinged to the side of the tub a short distance below the cover so that they can be swung up over the edge of the cover through slots

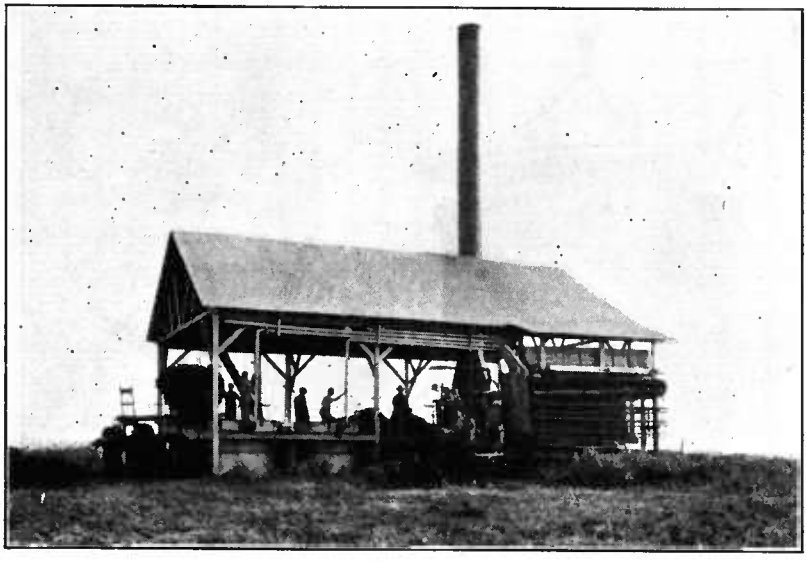

FIG. 12.—A four-tub mint still with worm condenser

and screwed down. The steam is admitted from a 1½-inch pipe just above the bottom. An even distribution of steam through the charge is effected by means of a cross T with open ends. The steam outlet is through a pipe from the side just below the cover. This pipe has a diameter several times as large as the inlet pipe, in order to prevent pressure from building up in the tub. It usually extends upward and then passes overhead to the condenser.

The metal tubs now generally being installed are constructed of No. 16 gauge galvanized steel. (Fig. 13.) The steam-tight gasket consists of a flat strip of composition material riveted to the rim of the tub or to the under edge of the cover. The cover is fastened down by means of adjustable eccentric clamps.

The condenser in common use, especially among the smaller growers, sometimes referred to as a worm condenser, consists of six or eight horizontal sheet-metal pipes joined at the ends by elbows to form a continuous series. (Fig. 14.) The first two lengths of pipe

from the top are 7 or 8 inches in diameter, and the remainder are reduced successively in size, the last one, from which the condensed oil and water flows, being 2 or 2½ inches in diameter. Condensation is obtained by water flowing over the pipe from a perforated trough mounted directly above the condenser. This water drains into a lead-off trough mounted below the third or fourth pipe, and a second perforated trough immediately below it furnishes a fresh supply of cold water for the remainder of the pipes. The water flows to the troughs by gravity from a reservoir overhead. A steady and ample supply of water is drawn by pumps either from wells or from small streams in the vicinity of the stills. The hot water which drips from the condenser is frequently used in the boiler, with a con-

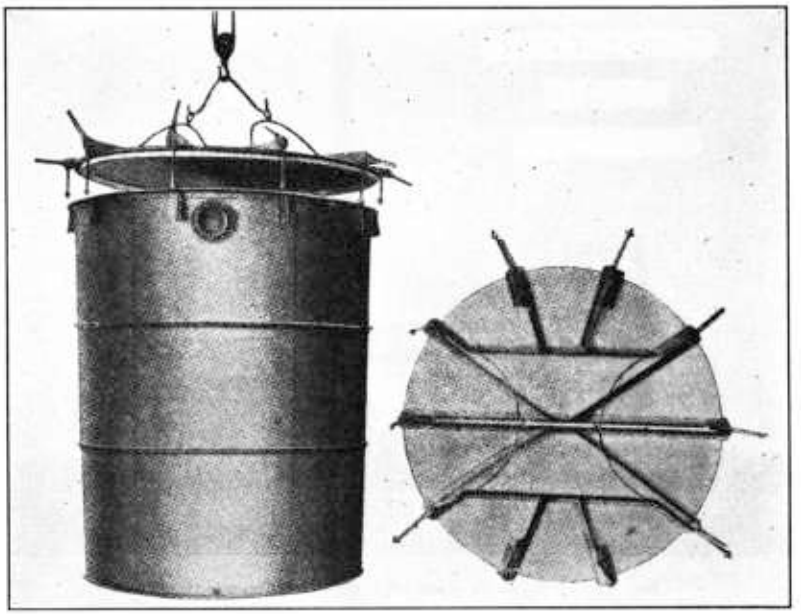

FIG. 13.—A type of galvanized-steel mint tub in common use

siderable saving of fuel. At some convenient point in the upper part of the condenser is an air vent which can be opened to admit air when the steam is shut off. This will prevent the condenser from collapsing, which otherwise is likely to occur because air can not enter fast enough through the small end of the condenser. The type of condenser described has come into extensive use mainly because it can be constructed at a small cost, but it is soon destroyed by rust. If built of copper pipe lined with tin it will last many years.

On the Pacific coast an equipment differing in some details from that described has long been in use. It consists of two metal tubs, each of which is fitted with an open collar around the rim about 5 inches wide and 10 inches deep. This collar is filled with water. The cover has a turned-down edge which fits into the collar, thus making a water seal. The vapors leave the retort through a gooseneck from the center of the cover and are conducted to a worm

condenser. The union of the exit pipe and condenser is also sealed with water by means of a similar arrangement. When the charge in the tub is exhausted the cover is lifted by means of a hoist and swung over for use with the other tub. With this type of equipment no clamps are required, but steam pressure must not be allowed to develop in the tub or the cover will be forced up and the seal broken.

A tubular condenser has lately come into use, which consists of an upright galvanized-steel shell in which are mounted numerous upright galvanized-iron pipes of small diameter, somewhat like the flues in a boiler. (Fig. 15.) As the steam and oil vapors pass down through the pipes from the top they are condensed by the cold

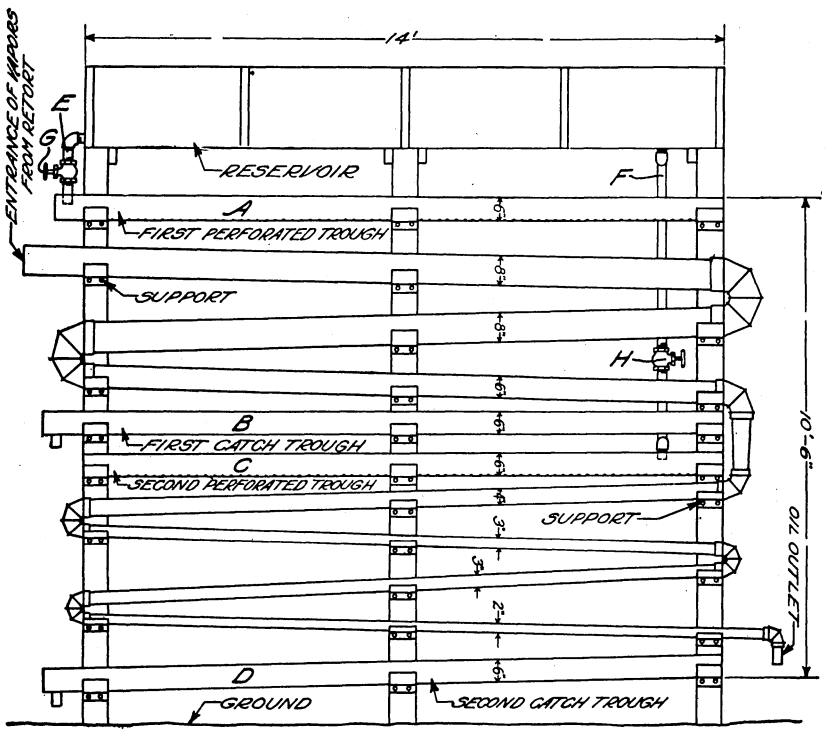

FIG. 14.—Details of a large single-unit worm condenser

water which circulates around the pipes, and the resulting water and oil flow from a narrow outlet into the receiver. Such a condenser is rather expensive, but it lasts a long time, requires but little space, and is very efficient. Figure 16 shows a modern still equipped with tubular condensers.

The receivers in which the oil is collected are of simple design and construction, varying from 10 to 50 gallons in capacity. They are made of galvanized iron and are cylindrical in shape. Since the oil floats on the water, the latter is drawn off the bottom as fast as it enters by means of a pipe which extends up along the side of the receiver to a few inches from the top, where it is fitted with an elbow or gooseneck. As the distillation proceeds the surface of

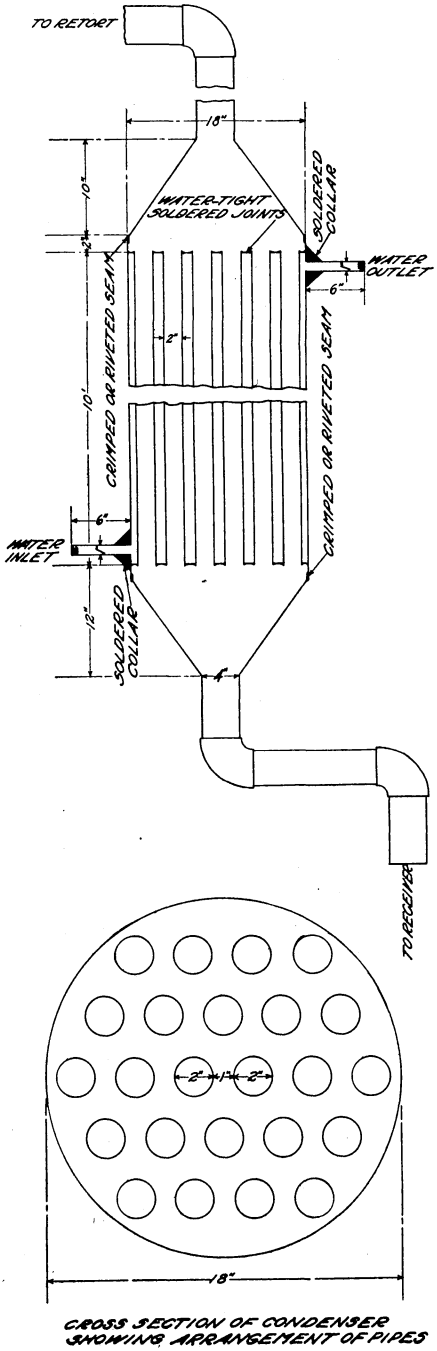

FIG. 15.—Details of a tubular condenser

the oil in the receiver is maintained at the same level as in the gooseneck from which the water drains. At a point about one-third the distance from the top of the receiver is an outlet with a stopcock from which the oil may be drawn off. A number of devices are used to prevent churning of the contents of the receiver by the flow from the condenser, since this might cause some of the oil to be drawn off with the water. One method is to direct the flow into a pipe with a funnel top which extends two-thirds the distance to the bottom of the receiver, where it is fitted with a short return elbow that directs the oil toward the surface. The receivers shown in Figure 17 are of this type. Another plan is to admit the stream from the condenser into the receiver at a point about two-thirds the way down by means of a pipe, a baffle plate immediately below the inlet directing the separated drops of oil upward toward the surface.

The efficiency of a distilling plant depends largely on an ample supply of steam. The boiler therefore should be of sufficient capacity for all purposes. In most cases it is operated at a steam pressure of about 85 pounds. The boiler is the most expensive unit in the distilling equipment, but a reconditioned boiler can usually be obtained at a considerable saving.

OPERATION OF STILLS

When a tub is charged, the herb is packed down thoroughly so that the steam will pass uniformly through the charge instead of channeling, as is likely

to be the case if the material is loosely or unevenly packed. An iron ring or a crosspiece with chains attached is placed on the bottom, and when the tub is half full the chains are laid across the charge and the steam partly turned on. A second ring is then introduced and the loading completed. By means of these rings and chains and a crane the spent herb can be readily removed from the tub in two batches. The slow admission of the steam while the loading is in progress makes it possible to pack the herb much more firmly. After the cover has been thoroughly clamped down, more steam is turned on, and when the condensed vapors of steam and oil begin to flow from the condenser the admission of steam is so adjusted that condensation is complete, with no loss of oil vapors.

The time required to exhaust a charge depends on the quantity of steam admitted and the condition of the herb. The drier the

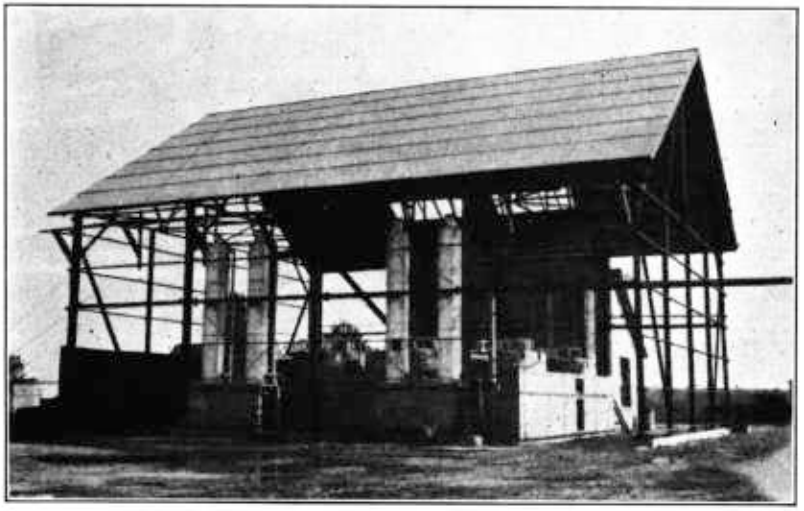

FIG. 16.—A partially completed mint still of modern design. Eight tubs are arranged in a circle, each one connected with a multitubular condenser

herb, the shorter the time required. Steam coming in contact with green herb is partly condensed, and a much longer time is therefore required to complete the operation. In most cases, if the herb has been well cured, the steaming is continued for about 45 minutes or an hour. This period is sufficient to permit the second tub to be emptied and reloaded.

The exhausted material is deposited on wagons or trucks by means of the crane and hauled away. If spread out on the field and properly dried it makes excellent fodder, and its use for this purpose is a common practice. It is relished by all kinds of stock and in feeding value is reported to be equal to timothy hay. It is also used to advantage as a fertilizer, and when intended for this purpose is spread on the field and plowed under in the fall. Some of the large growers at times deposit the refuse on large dumps, where it is allowed to decompose before being spread on the field.

The oil as it is removed from the receiver is stored in tin cans, usually of 5 or 10 gallons capacity, or where the distillation is conducted on a large scale it is placed in heavy drums holding 40 or 50 gallons. As a rule the oil separates readily from the water and if carefully removed is entirely clear. Some growers prefer to filter it before storing, but this is not usually necessary. Rectification by a second distillation is not generally necessary unless the oil is highly colored or of unusual composition. Under normal conditions if the fields have been kept free from weeds and distillation has been carefully conducted the oil obtained is entirely acceptable to the trade, and rectification, as a rule, will not sufficiently increase its market value to compensate for the cost of the treatment and the loss of oil

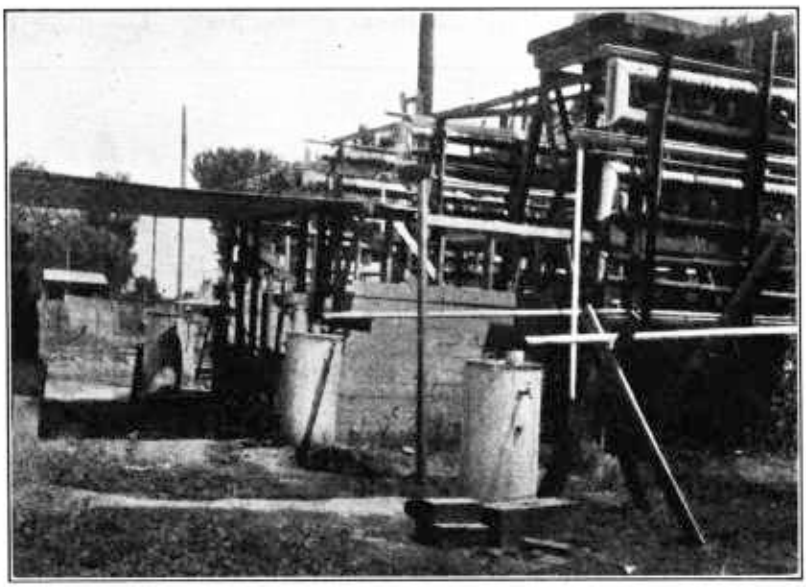

FIG. 17.—A view of the worm condensers and oil receivers of a mint still in California

resulting therefrom. The process can not generally be undertaken to advantage by the average grower, although it is frequently employed by the large producers.

Both peppermint and spearmint oils may be kept for an indefinite period without material change in quality if stored in a cool place in clean tin cans or in drums completely filled to exclude the air.

YIELD OF OIL

The yield of oil from the mints varies greatly according to seasonal conditions, the character of the crop, and the geographic location. In Michigan and Indiana 30 pounds of oil per acre is considered a fair average on well-managed farms. In seasons of unfavorable weather this average is greatly reduced, but, on the other hand, yields considerably in excess of this figure are frequently obtained from good fields when rainfall and temperature are normal. New

mint usually yields somewhat more oil than old mint, and on muck lands the crop is generally more productive than on upland. In Oregon and Washington the yields are higher, 80 and 90 pounds per acre being occasionally reported from the muck-land districts. The average on such lands is estimated at 50 to 55 pounds to the acre. In California, where the crop is cut twice, the seasonal average is still higher.

The largest yield of oil is obtained if the herb is harvested in the full-blooming stage. If the plants are too thick in the field to permit full leaf development, or if many of the lower leaves fall off on account of continued dampness due to the thick stand, the yield of oil is greatly reduced. Clear, sunny weather during the few weeks immediately preceding the harvest causes the herb to develop more oil than if cloudy, wet weather prevails. Heavy rains at harvest time wash off considerable oil, and rough and excessive handling of the herb if it has been permitted to become too dry also causes loss due to shattering of the leaves. Under similar cultural conditions peppermint and spearmint yield about the same quantity of oil per acre.

DISEASES AND PESTS

The mints are subject to few serious diseases. The most important of these is a rust fungus which frequently does severe damage by causing the loss of foliage during wet seasons. There are no practical control measures for this fungus, and the only way to avoid a total loss in fields heavily infested is to cut the crop before the disease is too far advanced. Lack of proper soil and moisture sometimes causes a chlorotic condition, evidenced by a yellowing of the leaves, which drop off in large numbers, but losses from this trouble are not general.

A serious insect pest, the mint flea beetle (*Longitarsus menthaphagus* Gentner) has in recent years caused much concern in the central region, according to the Bureau of Entomology. In the adult form this insect feeds on the foliage, its presence being usually first observed by the numerous small holes that appear in the leaves. The damage from this, although considerable at times, is of less importance than that caused by the larvae. In the late summer the beetle lays its eggs in the soil, and from these the larvae are hatched the next spring and enter into the main roots and underground stems of the mint plant, where they feed on the inside tissues, thereby causing the plant to wilt and die. In a field where these beetles are very numerous the crop will be largely destroyed by the larvae the following year if no control measures are undertaken. Dusting the fields with poison after the crop is removed and before the beetles have laid their eggs has given good results. Poison mixtures consisting of arsenicals mixed with talc, hydrated lime, or flour may be applied with large dusting machines, which can dust about 40 acres a day. The cost of this treatment is very low, and the control of the pest obtained thereby justifies its extensive use in beetle-infested districts. New mint subject to damage by the insects migrating from neighboring fields can be successfully protected by means of these poison dusts. Heavy damage by this insect at the present

time is by no means general, but its rapid spread in the Michigan-Indiana section is feared.[3]

Cutworms sometimes do much damage in the spring if the weather is wet and cold. Grasshoppers also are destructive in some seasons. Both of these pests can be controlled by means of poisoned bait.[4]

PRODUCTION COSTS

The cost of producing mint oil is variously estimated. The cost of preparing the ground, planting, cultivating, and harvesting is about $75 an acre, exclusive of fertilizers, taxes, and rental value of the land. Distilling costs are estimated at about 30 cents a pound of oil if the herb is of average quality. After the first year the cost is considerably less. In the Pacific coast district the establishment of a mint farm on new land is expensive if the entire cost of clearing the land is charged against it. However, since oil yields are generally higher than in the central region, the cost of production per pound is probably about the same. The class of labor available and the cost of hand weeding necessary are important factors. In New York State the growers are required to pay higher wages than in Michigan and Indiana, and consequently their production costs are considerably higher. On the whole it seems to be the general opinion that under present conditions mint oils can not be produced at less than $2.50 a pound on the average farm where both old and new mint are under cultivation.

A still, consisting of two metal tubs with a worm-type condenser and loading equipment but exclusive of the boiler, can be built for about $400. A new boiler of sufficient capacity costs about $1,000, but reconditioned boilers are usually available at a much smaller cost. A modern equipment, including four metal tubs, two of the best type condensers, oil receivers, horizontal bricked-in reconditioned boiler, secondhand hoisting engine, and loading platform, all housed in a well-constructed building, was recently built in Indiana for $4,000.

The grower who has less than 20 acres of mint under cultivation finds it more economical to haul his crop to a still in the neighborhood, if one is available, and pay the usual charge for such service, which varies from 30 to 50 cents a pound of oil. In localities where mint culture is a new undertaking a number of growers can advantageously equip and operate a still cooperatively until the acreage has been enlarged sufficiently to warrant individual equipment.

PRODUCTION AND CONSUMPTION OF MINT OILS

The United States is the principal producing country of peppermint and spearmint oils. England, Germany, France, and Italy produce relatively small quantities. Japan has under cultivation a vast acreage of a different species of mint which yields an oil of

---

[3] Information on the mint flea beetle and the methods of controlling it are contained in the following bulletin: GENTNER, L. G. THE MINT FLEA-BEETLE. Mich. Agr. Expt. Sta. Spec. Bul. 155, 13 p., illus. 1926.

[4] WALTON, W. R. GRASSHOPPER CONTROL IN RELATION TO CEREAL AND FORAGE CROPS. U. S. Dept. Agr. Farmers' Bul. 747, 18 p., illus. 1922. (Revised ed.)

——— CUTWORMS AND THEIR CONTROL IN CORN AND OTHER CEREAL CROPS. U. S. Dept. Agr. Farmers' Bul. 739, 8 p., illus. 1922. (Revised ed.)

different quality used largely as a source of natural menthol, of which it contains a high percentage.[5] Accurate statistics on the world's production of mint oils are not available. In this country the production averages about half a million pounds. In 1926 and 1927 the producton of peppermint oil reached approximately 700,000 pounds, but in the two years immediately preceding the crop was considerably below the average. The production of spearmint oil averages about 50,000 pounds. The use of peppermint oil in the manufacture of several widely used products that are in increasing demand assures a steady market. Considerable quantities of American oil are exported to other countries where the production is not sufficient to meet requirements.

Over a long period of years the average price received for the oil by peppermint growers has been less than $3 a pound. The trend in the price of spearmint oil has generally followed that of peppermint oil, largely because the production of both is similarly influenced by seasonal conditions. Unusual conditions sometimes result in much higher prices for these oils, but such prices can not safely be used in estimating the returns which may be expected from mint growing. The industry is especially subject to wide fluctuations in market conditions, and a period of attractive prices is likely to be followed by a sufficient extension of the acreage to cause overproduction.

---

[5] Japanese mint is grown to a very limited extent in the United States. Outside of scattered small acreages in North Carolina and Michigan, the only planting in this country is in central California, where there are approximately 400 acres. Information regarding the culture of this species of mint may be obtained from the Office of Drug, Poisonous, and Oil Plants, Bureau of Plant Industry, U. S. Department of Agriculture. The law does not permit the use of the term "peppermint" in the labeling of goods flavored with Japanese mint.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

January 30, 1929

Secretary of Agriculture	W. M. JARDINE.
Assistant Secretary	R. W. DUNLAP.
Director of Scientific Work	A. F. WOODS.
Director of Regulatory Work	WALTER G. CAMPBELL.
Director of Extension	C. W. WARBURTON.
Director of Personnel and Business Administration.	W. W. STOCKBERGER.
Director of Information	M. S. EISENHOWER.
Solicitor	R. W. WILLIAMS.
Weather Bureau	CHARLES F. MARVIN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Plant Industry	WILLIAM A. TAYLOR, *Chief.*
Forest Service	R. Y. STUART, *Chief.*
Bureau of Chemistry and Soils	H. G. KNIGHT, *Chief.*
Bureau of Entomology	C. L. MARLATT, *Chief.*
Bureau of Biological Survey	PAUL G. REDINGTON, *Chief.*
Bureau of Public Roads	THOMAS H. MACDONALD, *Chief.*
Bureau of Agricultural Economics	NILS A. OLSEN, *Chief.*
Bureau of Home Economics	LOUISE STANLEY, *Chief.*
Plant Quarantine and Control Administration	C. L. MARLATT, *Chief.*
Grain Futures Administration	J. W. T. DUVEL, *Chief.*
Food, Drug, and Insecticide Administration	WALTER G. CAMPBELL, *Director of Regulatory Work, in Charge.*
Office of Experiment Stations	E. W. ALLEN, *Chief.*
Office of Cooperative Extension Work	C. B. SMITH, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*

This bulletin is a contribution from

Bureau of Plant Industry	WILLIAM A. TAYLOR, *Chief.*
Office of Drug, Poisonous, and Oil Plants.	W. W. STOCKBERGER, *Principal Physiologist, in Charge.*

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
U.S.GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
5 CENTS PER COPY

▽